## REMARKS

Claims 1-3 and 5-9 remain in the case.

The specification is amended to correctly identify an issued patent that was referenced only by its attorney docket number in the original specification.

The rejection of claims 1-2, 4-7 and 9-10 under 35 U.S.C. 103(a) as being unpatentable over Minagawa ('797) in view of Powell or Tuckey ('455) is respectfully traversed.

Claim 1 and claim 6 recite a method for operating an automotive engine including fuel injectors that open to deliver fuel to the engine. A mechanical returnless fuel system is provided for supplying fuel to the fuel injectors and also includes a fuel pump having a pump output. The pump output is substantially constant. The controller regulates an opening time for the fuel injectors to deliver the precise quantity of fuel. A portion of the pump output is returned to the fuel pump supply.

The present invention includes a mechanical returnless fuel system using a fuel pump having a substantially constant output in cooperation with a non-constant pressure regulator valve. The office action suggests that Minagawa teaches the basic structure of applicants system; however, Minagawa describes an electronic returnless fuel system which changes the current provided to the fuel pump to increase/decrease the fuel pump output for controlling the fuel pressure provided to the fuel injectors. Fuel pressure is estimated based on the fuel flow supply rate which is controlled by the electric varying supply current. Minagawa is an entirely different basic structure than the present invention.

The office action further references Powell for modifying Minagawa to suggest the present invention. Powell only describes a fuel system that supplies a constant voltage to a fuel pump for operating

the fuel pump at a constant speed in cooperation with a conventional pressure regulator disposed within the fuel tank. Modifying Minagawa with the fuel pump and conventional pressure regulator (of Powell) can hardly be said to be combinable to suggest the present invention, nor is there motivation in either of the references to combine the references to teach or suggest the present invention. Minagawa controls the supply current to the fuel pump based upon feedback current to the fuel pump and a target current value. Utilizing the constant output pump (of Powell) in the electronic returnless fuel system of Minagawa adds nothing more than providing a fuel pump (that typically has a constant output) in a system that varies the supply current to the fuel pump for controlling fuel pressure and flow rates to the injectors. The components and methods for controlling the pressure and flow rates to the injectors of the present invention are completely different than the controls and methodology for an electric returnless fuel system. This mere implementation of a constant output pump and conventional pressure regulator in the electrical returnless fuel system does not teach or suggest the present invention.

Furthermore, Powell uses a conventional pressure regulator in cooperation with the fuel pump to control fuel pressure to the engine. The office action states on page 3 last sentence, "the examiner cannot see how the regulator disclosed by the applicant would function any differently than that taught by Powell or Tuckey." The difference in the applicant's pressure regulator valve and conventional pressure regulators is expressly pointed out in applicant's specification which distinguishes between applicant's invention and other conventional fuel systems. Paragraph [0012] states as follows:

> Fuel system 10 also includes a pressure regulating valve 22 that is coupled to fuel line 20 within tank 16 and returns a portion of the pumped fuel to the fuel supply through return line 28. A preferred pressure regulating valve is described in U.S. patent 6,953,026 issued October 11, 2005, incorporated herein by reference. The preferred

valve comprises a frustoconical valve body that is biased by a coil spring against a valve seat in the closed position. The valve body slides in response to increased fuel pressure within the fuel line to contract the coil spring and space the valve body apart from the valve seat, thereby opening the valve for fluid flow through return line 28. It is a feature that the pressure regulating valve produces a fuel pressure in fuel line 20 that varies as a function of fuel flow to the engine. Referring to FIG. 2, there is depicted a graph showing fuel pressure P in the fuel line as a function of engine fuel flow rate Q. The engine fuel flow rate Q corresponds to the engine fuel usage, which is also referred to as actual engine fuel demand, and is equal to the output of fuel pump 14 minus the portion of fuel returned to the fuel supply through pressure regulating valve 26. Line 70 shows a relationship wherein fuel line pressure P increases in direct proportion to engine fuel flow rate Q which may be provided by a pressure regulating valve suitable for use with this invention. For purposes of comparison, line 72 represents an idealized situation that provides a substantially constant pressure independent of fuel flow rate, such as is provided by a diaphragm-type pressure regulator in a conventional mechanical returnless fuel system. Thus, there is a significant discrepancy between the actual fuel line pressure, as shown for line 70, and a theoretical constant pressure, such as might be provided by line 70, particularly at relatively low or high fuel flow rates. As a result, a controller calculating injector opening times based upon an arbitrary constant fuel pressure may calculate an opening time that delivers a quantity of fuel that deviates significantly from the desired controlled quantity.

As shown above, the conventional fuel systems utilize a pressure regulator that comprises a diaphragm-type regulator that opens to relieve pressure. Such diaphragm-type regulators are very effective for maintaining a constant fuel pressure, but add significant cost to the fuel system. Applicant is utilizing a pressure regulator valve, which is incorporated by reference (see paragraph [0012]), that is a much less expensive design, and unlike conventional pressure regulators, the pressure is not constant since it does not utilize a diaphragm. Rather, the pressure is linearly proportional to the fuel flow rate as shown in Fig.

2 comparing element 70 (applicant's pressure regulator valve) with element 72 (ideal pressure/conventional pressure regulator's utilizing a diaphragm).

As a result, the present invention overcomes the difficulties of utilizing a pressure regulator valve that does not maintain constant pressure. This is neither shown nor described in Powell or Tuckey. In fact, Powell references three patents (US 5193576, US5163472, US 5193576) as examples of the convention by-pass pressure regulators that are used in its system (see col. 2, lines 25-30). These references utilize conventional diaphragm-type pressure regulators.

Tuckey utilizes a pressure relief valve which is different than a pressure regulated valve.

Minagawa, Powell, and Tuckey fail to teach or suggest, either individually or in combination, the limitations of claims 1 and 6. Therefore, claims 1 and 6 are allowable.

Claims 2 and 7 recite a pressure regulating valve for returning a portion of the pump output to the fuel supply demand. The pressure regulating valve produces a fuel pressure that varies as a function of the engine fuel demand.

Minagawa, Powell, and Tuckey fail to teach or suggest, either individually or in combination, the limitations of claims 2 and 7. Therefore, claims 2 and 7 are allowable.

The rejection of claims 3 and 8 under 35 U.S.C. 103(a) as being unpatentable over Morikawa and Minagawa, and in further view of Gaskins.

Morikawa describes a mechanical returnless fuel system where fuel pressure is controlled based on a solenoid operated valve. The design functions quite differently from the present invention using distinct hardware and methodology to control pressure of fuel applied to the injectors.

Minagawa describes an electrical returnless system wherein the fuel pump output is controlled via the current to the fuel pump to provide fuel to the engine. This also functions differently using distinct hardware and methodology to control pressure.

Gaskins describes a return fuel system wherein fuel pressure is controlled by either adjusting the operating speed of the fuel pump or by controlling pressure with a pressure regulator that is disposed outside of the fuel tank and is coupled to a fuel return line which is different in design and methodology than the present invention. Gaskins also describes a calibration look-up table for adjusting the pulse width operation of the fuel injectors. The look-up table in claims 3 and 8 is used to correlate the engine fuel flow rate with the fuel pressure and utilizes the projected engine fuel demand as the fuel flow rate to determine the estimated fuel pressure. This is neither shown nor suggest by Morikawa, Minagawa, and Gaskins either individually or in combination. Therefore, claims 3 and 8 are allowable.

Claim 9 depends from claim 6 and is therefore allowable.

In view of the foregoing amendment and remarks, all pending claims are in condition for allowance. Favorable action is respectfully solicited.

Respectfully submitted,

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